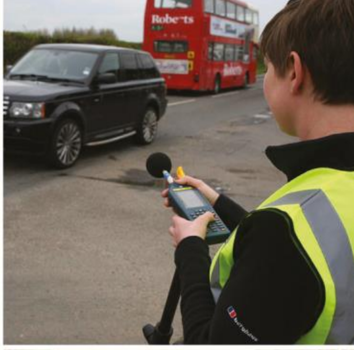
M·EC ACOUSTIC AIR






ASHLAND ROAD WEST, SUTTON IN ASHFIELD

NOISE ASSESSMENT

FEBRAURY 2020

REPORT REF: 25412-04-NA-01 REV B

Noise, Vibration, Air Quality and Odour

ASHLAND ROAD WEST,
SUTTON IN ASHFIELD

NOISE ASSESSMENT

FEBRAURY 2020

REPORT REF: 25412-04-NA-01 REV B

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REGISTRATION OF AMENDMENTS

REV	COMMENTS AND CHANGES
First Issue Oct 2019	Final issue for Planning
A Feb 2020	Updated Masterplan
B Feb 2020	Updated Location Plan

CONTENTS

APPENDICES

1.0 INTRODUCTION

1.1 Mewies Engineering Consultants Ltd (M-EC Acoustic Air) has been commissioned by Bellway Homes Ltd (East Midlands) to prepare a noise assessment for the proposed residential development on land at Ashland Road West, Sutton in Ashfield.

1.2 The principle sources of noise influencing sound levels at the site will be road traffic using Ashland Road West adjacent to part of the south eastern site boundary. A site location plan is presented in Appendix A.

Assessment Scope

1.2 The noise assessment has been undertaken with regard to Professional Practice Guidance on Planning & Noise (ProPG), prepared jointly by the Association of Noise Consultants , the Institute of Acoustics and the Chartered Institute of Environmental Health , which seeks to secure good acoustic design for new residential development within England's planning system, and British Standard BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'.

1.3 A site description is provided in Section 2.0 of this report. Relevant national guidance on noise is presented in Section 3.0. Section 4.0 presents the methodology of the noise assessment, and the noise survey results, assessments and recommendations for mitigation are presented in Section 5.0. Our conclusions are summarised in Section 6.0.

1.4 M-EC has completed this report for the benefit of the individuals referred to in paragraph 1.1 and any relevant statutory authority which may require reference in relation to approvals for the proposed development. Other third parties should not use or rely upon the contents of this report unless explicit written approval has been gained from M-EC.

1.5 M-EC accepts no responsibility or liability for:

a) The consequence of this documentation being used for any purpose or project other than that for which it was commissioned;

b) The issue of this document to any third party with whom approval for use has not been agreed.

2.0 SITE DESCRIPTION

Existing Site

2.1 The application site is located adjacent to Ashland Road West, which runs adjacent to part of the south eastern site boundary. Brierley Forest Park is located to the north, with existing residential to the east, south and west. The principle sources of noise affecting the site is from road traffic using Ashland Road West.

2.2 A site location plan is provided in Appendix A.

Development Proposals

2.3 The development proposals are for the erection of approximately 300 residential dwellings subject to final design.

2.4 The site masterplan is provided in Appendix B.

3.0 NOISE CRITERIA

Noise Terms and Units

3.1 Noise levels are measured and assessed using the decibel scale (dB), which provides a measure of the air pressure changes due to vibrating sources such as vehicle engines or machinery. Due to the vast range of air pressures that the human ear is capable of detecting, the decibel measurement uses a logarithmic scale that compresses the data into a more manageable scale for assessment purposes. A detailed explanation of the derivation of the decibel scale is presented in Appendix C.

3.2 Due to the logarithmic nature of the dB scale, the addition of two or more noise levels has to be done logarithmically rather than arithmetically. For example, two equal sound sources each producing 50 dB, when operated simultaneously, do not result in a noise level of 100 dB but instead produce a combined level of 53 dB, i.e. a rise of 3 dB for each doubling of sound energy. Subjectively, a 3 dB change does not represent a doubling or halving of loudness; to make a sound appear twice or half as loud requires a change of 10 dB.

3.3 The subjective loudness of noise can be measured by applying a filter or weighting that equates to the frequency response of the human ear. This is referred to as an A-weighting and when applied results in noise levels expressed as dB(A). dB(A) noise levels reflect the human perception of loudness.

National Planning Policy Framework

3.4 The latest National Planning Policy Framework (NPPF) 2019 sets out the Government's planning policies for England and how these are to be expected to be applied. The NPPF must be taken into account in the preparation of local and neighbourhood plans, and is to be a material consideration in planning decisions.

3.5 Paragraph 170 of the NPPF advises that, with respect to noise, planning policies and decisions should contribute to and enhance the natural and local environment by *"...preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution ...*"

3.6 Further, paragraph 180 advises that "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life; and*

b) *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

3.7 The NPPF's footnote to point a) above explicitly refers to the Explanatory Note to the *Noise Policy Statement for England* (Department for Environment, Food & Rural Affairs, 2010).

Noise Policy Statement for England

3.8 The guidance of the Noise Policy Statement for England (NPSE) applies to all forms of noise including environmental noise, neighbour noise and neighbourhood noise, but does not apply to noise in the workplace (occupational noise). It introduces the concepts of 'No Observed Effect Level' (NOEL), which is the level below which there is no detectable effect on health and quality of life due to the noise; the 'Lowest Observed Adverse Effect Level' (LOAEL), which is the level above which adverse effects on health and quality of life can be detected; and the 'Significant Observed Adverse Effect Level' (SOAEL), which is the level above which significant adverse effects on health and quality of life occur.

3.9 In March 2014 the Department for Communities & Local Government updated its on-line planning guidance to assist with interpretation of the original NPPF and the NPSE. The guidance covers general matters such as relevance of noise issues, noise concerns and factors, how to determine impacts, and mitigation. To assist with recognising when noise could be a concern, the guidance summarises the noise exposure hierarchy as follows, based on the likely average response

Table 1: Noise Exposure Hierarchy Based on Likely Average Response

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid

Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

BS8233:2014 'Guidance on sound insulation and noise reduction for buildings'

3.10 For steady external noise sources, BS8233:2014 states that it is generally desirable that the internal ambient noise level does not exceed the guideline values in Table 2.

Table 2: Indoor ambient noise levels for dwellings

Activity	Location	Daytime 07:00 to 23:00	Night-time 23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

NOTE 1 *Table 2 provides recommended levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Groundborne noise is assessed separately and is not included as part of these targets, as human response to groundborne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.*

NOTE 2 *The levels shown in Table 2 are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 2.*

NOTE 3 *These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Years Eve.*

NOTE 4 *Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,P}$ depending on the character and number of events per night. Sporadic noise events could require separate values.*

NOTE 5 *If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.*

NOTE 6 *Attention is drawn to the building regulations (30, 31, 32).*

NOTE 7 *Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.*

3.11 For traditional external areas that are used for amenity space, such as gardens and patios, the BS says it is desirable that "*the external noise does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$.*"

3.12 However, due to the nationwide difficulty in satisfying an external noise criterion of 55 dB $L_{Aeq,T}$ in urban areas where transportation noise is prevalent, BS8233:2014 provides an over-arching consideration of how to treat outdoor garden areas in the following way:

"… it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses."

Professional Practice Guidance on Planning & Noise, New Residential Development, May 2017

3.13 The Professional Practice Guidance on Planning & Noise (ProPG), prepared jointly by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH), seeks to secure good acoustic design for new residential development within England's planning system.

3.14 The guidance includes a framework to enable situations where noise is not an issue to be clearly determined, and to help identify the extent of risk at noisier sites. However, the guidance does not constitute an official government code of practice and neither replaces nor provides an authoritative interpretation of the law or government policy.

3.15 The scope of the guidance is also restricted to sites that are exposed predominantly to noise from transportation sources. Where industrial or commercial noise is present on the site but is "not dominant", its contribution may be included in the noise level used to establish the degree of risk. Where industrial or commercial noise is present on the site and is considered to be "dominant", then the risk assessment should not be applied to the industrial or commercial noise component and regard should be had to the guidance in BS4142:2014.

3.16 The ProPG advocates a 2-stage approach covering:

- Stage 1 – an initial noise risk assessment of the proposed development site;
- Stage 2 – a systematic consideration of four key elements.

3.17 The four key elements to be undertaken in parallel during Stage 2 of the assessment are:

1. demonstrating a "Good Acoustic Design Process";
2. observing internal "Noise Level Guidelines";

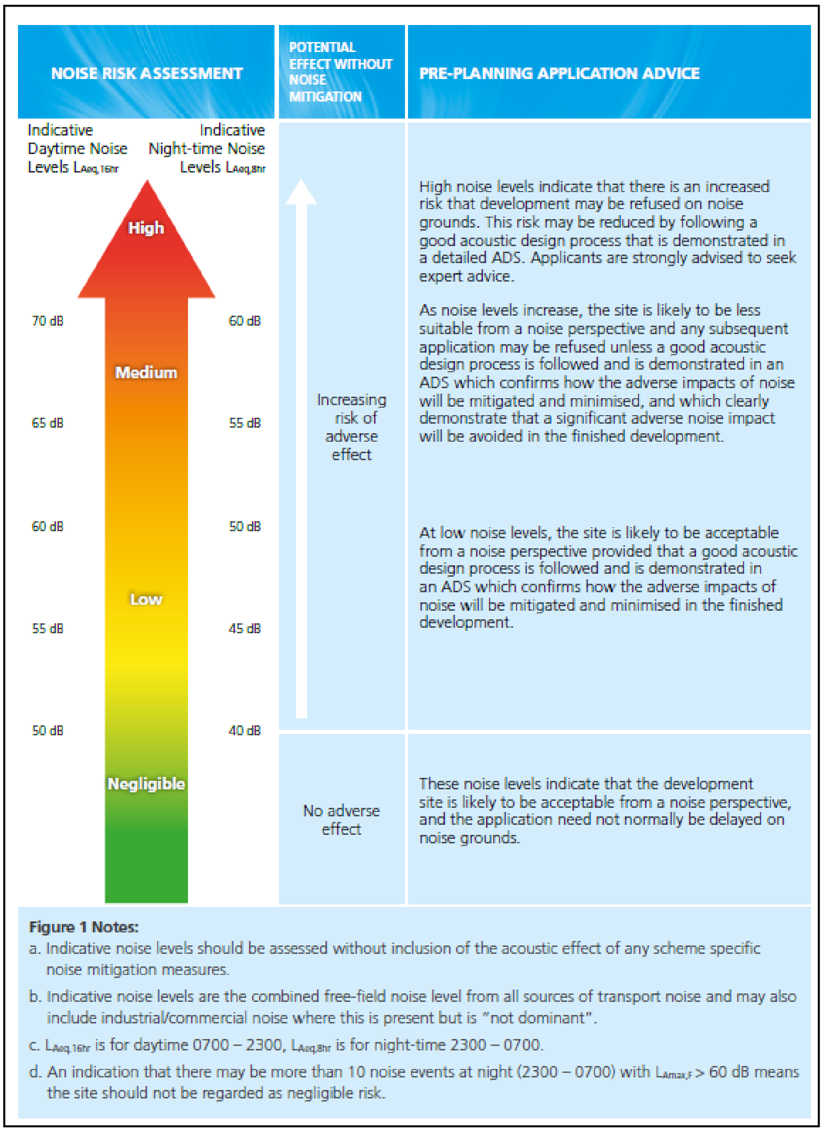
3. undertaking an "External Amenity Area Noise Assessment"; and

4. consideration of "Other Relevant Issues".

3.18 The overall approach is underpinned by the preparation of an "Acoustic Design Statement" (ADS), for which guidance is contained in ProPG Supplementary Document 2, Good Acoustic Design. An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk, and an ADS should not be necessary for a site assessed as negligible risk. The ProPG's Supplementary Document 1, Planning & Noise Policy Guidance provides additional information regarding other planning guidance.

3.19 The process for the Initial Site Noise Risk Assessment is summarised in Figure 1. The site's day and night-time noise exposures are used to define whether the site falls into a negligible, low, medium or high risk noise category. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds.

Figure 1: Initial Site Noise Risk Assessment



3.20 Elements 1 and 2 of the Stage 2 assessments utilise the noise levels at new dwellings to determine the good acoustic design to avoid 'unreasonable' acoustic conditions and prevent 'unacceptable' acoustic conditions. The internal noise level guidelines used by ProPG are largely those previously set out under BS8233:2014 (Table 2) but with some additional guidance intended to assist with the determination of 'unreasonable' and 'unacceptable' acoustic conditions, which, for clarity, are highlighted by the use of blue italic font in the notes to Table 3.

Table 3: ProPG Internal Noise Level Guidelines

ACTIVITY	LOCATION	07:00 – 23:00 HRS	23:00 – 07:00 HRS
Resting	Living room	35 dB $L_{Aeq,16 hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16 hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16 hr}$	30 dB $L_{Aeq,8 hr}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 1 The Table provides recommended internal L_{Aeq} target levels for overall noise in the design of a building. These are the sum total of structure-borne and airborne noise sources. Ground-borne noise is assessed separately and is not included as part of these targets, as human response to ground-borne noise varies with many factors such as level, character, timing, occupant expectation and sensitivity.

NOTE 2 The internal L_{Aeq} target levels shown in the Table are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the internal L_{Aeq} target levels recommended in the Table.

NOTE 3 These internal L_{Aeq} target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

NOTE 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded, subject to the further advice in Note 7.

NOTE 6 Attention is drawn to the requirements of the Building Regulations.

NOTE 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form **(see Section 3.D)**.

3.21 Element 3 of the ProPG's Stage 2 assessment applicable to External Amenity Area Noise Assessment similarly extends the current guidance applicable to outdoor areas in the following manner:

3(i) *"If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.*

3(ii) *The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB LAeq,16hr.*

3(iii) *These guideline values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces.*

3(iv) *Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.*

3(v) *Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:*

- *a relatively quiet facade (containing openable windows to habitable rooms) or a relatively quiet externally ventilated space (i.e. an enclosed balcony) as part of their dwelling; and/or*
- *a relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
- *a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and/or*
- *a relatively quiet, protected, publically accessible, external amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance). The local planning authority could link such provision to the definition and management of Quiet Areas under the Environmental Noise Regulations."*

3.22 The final element of Stage 2 is an assessment of other relevant issues, which may include the following matters:

4(i) *"compliance with relevant national and local policy;*

4(ii) *magnitude and extent of compliance with ProPG;*

4(iii) likely occupants of the development;

4(iv) acoustic design v unintended adverse consequences;

4(v) acoustic design v wider planning objectives."

3.23 Upon completion of the ProPG's Stage 1 and 2 assessments, the findings should enable one of four possible recommendations to be presented to the decision maker, namely to grant permission without conditions, grant with conditions, 'avoid' or 'prevent'.

4.0 METHODOLOGY

Noise Survey

4.1 Ambient noise levels at the proposed site during the day and night-time were monitored from Thursday 3rd to Friday 4th October 2019. Noise levels were monitoring continuously over a 24-hour period at 4m from the carriageway edge of Ashland Road West (Position 1). Further sample measurements were undertaken along the northern boundary (Position 2) and along the western boundary (Position 3). The noise monitoring positions are identified in Appendix A.

4.2 Noise levels were recorded using the following equipment, which was calibrated to a reference signal of 94 dB immediately prior to and after the survey and exhibited zero drift.

- Norsonic 131 Type 1 Sound level meter;
- Norsonic 130 Type 1 Sound level meter; and
- Larson Davies CA200 acoustic calibrator.

4.3 The microphone was positioned at a height of 1.5m in a free-field location, i.e. excluding the effect of reflections from buildings or structures. The weather conditions were overcast and cool, with south westerly winds of up to 2 m/s during Thursday, raining overnight, and overcast and cold, with south westerly winds of 1.5 m/s during Friday. The rainfall during the night-time measurement period will have increased the noise exposure.

4.4 During the survey periods, the predominant noise source affecting the site was at all times road traffic using Ashland Road West.

5.0 RESULTS, ASSESSMENT AND MITIGATION

Results

5.1 Measured noise levels are presented in Appendix D and are summarised below in Table 4.

Table 4: Measured Noise Levels, Free-field dB(A)

Situation	Time	L_{Aeq}	L_{Amax}	L_{A01}	L_{A10}	L_{A90}
Position 1 Daytime	1524-2300	54.5	83.8	65.1	55.1	40.5
Position 1 Night-time	2300-0700	48.0	74	51.8	43.6	38.1
Position 1 Daytime	0700-1530	56.4	87.3	67.1	58.8	40.7
Position 2 Daytime	1330-1355	45.8	61.6	51.5	48.1	42.7
Position 3 Daytime	1410-1435	43.5	62	49.8	45.3	40.6

5.2 The day and night-time $L_{Aeq\ T}$ measured at Position 1 were 56 dB and 48 dB respectively (rounding to the nearest whole number for assessment purposes), with a night-time L_{Amax} of 74 dB.

5.3 The daytime $L_{Aeq\ T}$ monitored at positions 2 and 3 were lower, and ranged from 44 dB to 46 dB.

Assessment

5.4 An Initial Site Noise Risk Assessment as required by the ProPG is presented in Table 5. Based on the maximum noise exposure levels recorded on the site, the site immediately adjacent to Ashland Road West falls within the category of Low risk, for which the guidance indicates that, *“At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development.”*

5.5 Away from the direct effects of road traffic using Ashland Road West, the noise exposure reduces to a Negligible risk, for which the guidance states, *“These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.”*

Table 5: Initial Site Noise Risk Assessment

Risk Category	Negligible		Low		Medium		High	
Period	Day	Night	Day	Night	Day	Night	Day	Night
ProPG L_{Aeq} threshold dB	<50	<40	50-60	40-50	60-70	50-60	>70	>60
Site Noise Level L_{Aeq} dB, Ashland Road West					56	48		
Risk Assessment					**Medium**			

Mitigation

5.17 External and internal sound levels for new dwellings closest to Ashland Road, i.e. at an indicative distance of 5m from the carriageway edge, as shown on the site masterplan provided in Appendix B, would be as shown in Table 6. The Table also shows the sound reduction (R_w) that windows to habitable rooms must provide in order to achieve BS8233's noise limits, e.g. an internal noise level of 35 dB L_{Aeq} during the day for living rooms and 30 dB L_{Aeq} and 45 dB L_{Amax} during the night for bedrooms.

Table 6: External and Internal Sound Levels of New Dwellings at 5m from the Carriageway Edge of Ashland Road West, dB

Day L_{Aeq}					Night L_{Aeq}			
Façade	Acoustic Performance Requirement		Vent $D_{,n,e,w}$	Garden	Façade	Acoustic Performance Requirement		Vent $D_{,n,e,w}$
	R_W	R_{TRA}				R_w	R_{TRA}	
57	22	17	29	54	49	19	14	26
					Night L_{Amax}			
					Façade	Acoustic Performance Requirement		Vent $D_{,n,e,w}$
						R_w	R_{TRA}	
					75	30	25	37

Note: Façade noise level includes +3 dB correction for façade reflection effects.

5.17 Table 6 shows that in order to achieve BS8233's internal L_{Aeq} and L_{Amax} noise levels, windows will need to provide a minimum sound reduction (R_W) of no more than 30 dB R_W. Data for the sound insulation performance of different window configurations (Appendix E) indicates that normal thermal double glazing having a configuration of 4/12/4 or 4/16/4 (where the information is presented in terms of the thickness of one pane of glass in mm, followed by the size of the air gap, followed by the thickness of the second pane of glass), typically provides a sound reduction of 31 dB R_W, which would be more than sufficient to meet all internal noise standards. Window manufacturers will be able to provide certification showing which of their window designs are capable of achieving the required sound reductions.

5.18 Background ventilation must be provided in accordance with the Building Regulations Approved Document F. To achieve this, window mounted trickle vents or through-wall ventilators that are acoustically attenuated to provide an equivalent sound reduction to the glazing may be installed.

5.19 The ProPG recommends that "*Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however, any facade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the 'open' position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded*". This means that the acoustic vent when 'open' should provide a sound reduction no less than that provided by the window.

5.20 The sound reduction performance of acoustic ventilators is usually specified as a $D_{n,e,w}$ rating. In order to provide a sound reduction equivalent to that of the specified glazing, the $D_{n,e,w}$ value of the vent (when open) should be at least 7dB higher than the specified R_W of the glazing. For example, for a window providing an R_w of 31 dB, the vent, when open, should be selected to at least provide 38 dB $D_{n,e,w}$, i.e. window R_w + 7 = required minimum $D_{n,e,w}$.

5.21 The unscreened outdoor noise level of 56 dB $L_{Aeq\ T}$ measured at 4m from the carriageway edge of Ashland Road West exceeds the BS8233 outdoor criterion of 55 dB, although only marginally. Nevertheless, with the addition of 1.8m high acoustic fence along garden boundaries to minimise the traffic noise impacts in accordance with BS8233, any site layout can be adopted adjacent to the road without the outdoor noise criterion being exceeded.

Summary

5.22 The above acoustic design statement demonstrates that relevant recommended external and internal noise standards can be met, and there are no other outstanding noise issues. Therefore, the overall conclusion of the noise assessment is that the decision maker may grant planning permission with conditions where appropriate.

6.0 CONCLUSIONS

6.1 Mewies Engineering Consultants Ltd (M-EC Acoustic Air) has been commissioned by Bellway Homes Ltd (East Midlands) to prepare a noise assessment for the proposed residential development on land at Ashland Road West, Sutton in Ashfield.

6.1 An Initial Site Noise Risk Assessment required by the ProPG shows that the site immediately adjacent to Ashland Road West falls within the category of Low risk, for which the guidance indicates that, *"At low noise levels, the site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development."*

6.2 Away from the direct effects of road traffic using Ashland Road West, the noise exposure reduces to a Negligible risk, for which the guidance states, *"These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds."*

6.3 The proposed general mitigation strategy for the site includes all or a combination of:

- Selection of glazing, acoustically attenuated ventilation and building fabric with a sufficient sound reduction index; and
- Installation of 1.8m high acoustically sound fencing at garden boundaries adjacent to Ashland Road West.

6.4 The assessment confirms that a good standard of acoustic design, in accordance with the latest ProPG guidance can be achieved, using reasonable and practicable design measures.

6.5 It is considered that with the implementation of the specified mitigation strategy, sound levels across the proposed development can be readily attenuated to achieve acceptable external and internal sound levels.

APPENDIX A

M-EC
The Old Chapel
Station Road
Hugglescote
Leicestershire
LE67 2GB

SITE LOCATION PLAN & NOISE MONITORING POSITIONS

Project: Ashland Road, Sutton in Ashfield

File Ref: 25412

O.S. Grid Ref: 447899,359480

● 24-hour measurement (or 3-hour day and 1-hour night)

● Sample measurements

APPENDIX B

Ashland Road West, Sutton in Ashfield - **Illustrative Masterplan**

| Drawn by: LJE | Approved by: PS | Date: 24/01/20 | Scale: 1:1250 @ A1 | DRG: P19-1014 007 Sheet No: 1 Rev: B | Client: Bellway Homes |

Pegasus Group

APPENDIX C

DESCRIPTION OF NOISE UNITS

- The sounds that we hear are a result of successive air pressure changes. These air pressure changes are generated by vibrating sources, such as motor vehicle engines, and they travel to a receiver, i.e. the human ear, as air pressure waves.

- The human ear is capable of detecting a vast range of air pressures, from the lowest sound intensity that the normal ear can detect (about 10^{-12} watts/m^2) to the highest that can be withstood without physical pain (about 10 watts/m^2). If we were to use a linear scale to represent this range of human sensitivity it would encompass a billion units. Clearly this would be an unmanageable scale yielding unwieldy numbers.

- The scale can be compressed by converting it to a logarithmic or Bel scale, the number of Bels being the logarithm to the base 10 of one value to another (as applied by Alexander Graham Bell to measure the intensity of electric currents). The Bel scale gives a compressed range of 0 to 12 units which in practice is a little too compressed. A change of 1 Bel represents a doubling or halving of loudness to the average listener. A more practical operating range of 0 to 120 is obtained by multiplying by 10, i.e. 10 x Bel, which produces the scale units known as decibels or dB.

- Examples of typical sound intensity levels within the decibel range of 0 to 120 dB are listed below:

Four engine jet aircraft at 100m	120 dB
Riveting of steel plate at 10m	105 dB
Pneumatic drill at 10m	90 dB
Circular wood saw at 10m	80 dB
Heavy road traffic at 10m	75 dB
Telephone bell at 10m	65 dB
Male speech, average at 10m	50 dB
Whisper at 10m	25 dB
Threshold of hearing, 1000 Hz	0 dB

- Due to this logarithmic scale noise levels have to be combined logarithmically rather than arithmetically. For example, two equal sound sources of 70 dB each, when operated simultaneously, do not produce a combined level of 140 dB but instead result in a level of 73 dB, i.e. a rise of 3 dB for each doubling of sound intensity. Subjectively, a 3 dB change does not represent a doubling or halving of loudness; to make a sound appear twice as loud requires an increase in sound pressure level of about 10 dB.

- The sensitivity of the human ear to different acoustic frequencies of sound can be taken into account when measuring or calculating noise by applying a filter or weighting which equates to the frequency response of the human ear. This is referred to as an A-weighting and when applied results in noise levels expressed as dB(A). dB(A) noise levels reflect the human perception of loudness.

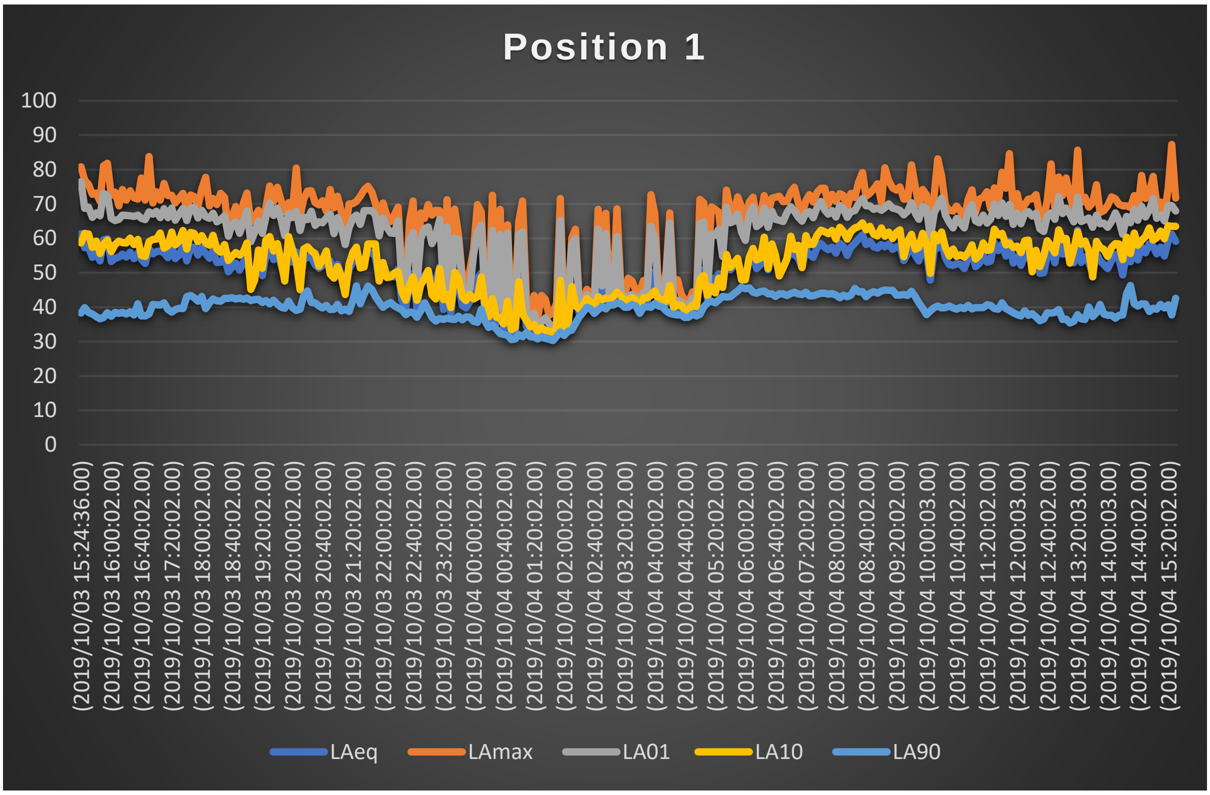
- Due to the often broadband and variable nature of environmental noises such as traffic, people exposed to different levels of noise do not make consistently different judgements about the noise climate until the difference in average noise level is about 3 dB(A). This is equivalent to a doubling of sound energy or, for example, a doubling of traffic flow. However, individuals are able to detect much lesser changes in noise exposure in any given situation and under ideal conditions can detect differences of as little as 1dB.

- Noise levels that fluctuate over time can be measured using a variety of noise indices. One index that correlates fairly well with community annoyance due to road traffic noise is the $L_{A10\ (18\text{-hour})}$ noise index. The L_{A10} is the A-weighted sound level exceeded for 10% of the time, and the $L_{A10\ (18\text{-hour})}$ is the arithmetic mean of the 18 hourly L_{A10} values during the period 6am to midnight (0600 to 2400 hours).

- An alternative index used in the UK to characterise intermittent sources of noise such as railways or construction sites is the equivalent continuous noise level, L_{Aeq}. It is a measure of the total sound energy generated by a fluctuating sound signal within a given time period and can be derived by 'spreading' the total sound energy evenly over the same time period as the fluctuating signal, hence the term 'equivalent continuous noise level'.

- Other useful noise units include the L_{Amax}, which is the maximum A-weighted sound level often used to characterise single events, and the L_{A90} which is the level of noise exceeded for 90% of the time and is an indicator of the background noise levels in the absence of specific sources such as traffic.

APPENDIX D



Date/Situation	**L_{Aeq}**	**L_{Amax}**	**L_{A01}**	**L_{A10}**	**L_{A90}**
Position 1 Daytime					
(2019/10/03 15:24:36.00)	61.4	80.8	76.5	58.7	38.3
(2019/10/03 15:25:03.00)	57.3	76.9	68.7	61.5	39.9
(2019/10/03 15:30:02.00)	57.5	75.7	69.1	61.3	38.5
(2019/10/03 15:35:02.00)	54.5	72.8	66.1	57.4	38
(2019/10/03 15:40:02.00)	55.7	73.2	67.4	59.2	37.3
(2019/10/03 15:45:02.00)	53.5	70.8	66.6	55.6	36.6
(2019/10/03 15:50:02.00)	59.6	81.1	73.1	58.3	37
(2019/10/03 15:55:03.00)	59.9	81.8	72.4	59.5	38.4
(2019/10/03 16:00:02.00)	53.3	72.5	65.8	56.2	37.4
(2019/10/03 16:05:02.00)	54.2	73.5	65.2	58.2	38.5
(2019/10/03 16:10:02.00)	54.6	69.5	65.6	59.2	38.2
(2019/10/03 16:15:02.00)	55.4	74.2	66.8	58.8	38.5
(2019/10/03 16:20:02.00)	54.6	71.1	66.7	58.7	38
(2019/10/03 16:25:02.00)	56	73.8	66.6	60.1	38.7
(2019/10/03 16:30:02.00)	54.1	71.8	66.4	58.2	37.7
(2019/10/03 16:35:02.00)	55.7	71.4	66.8	59.7	41
(2019/10/03 16:40:02.00)	53.9	77.6	65.8	55	37.5
(2019/10/03 16:45:03.00)	52.7	71.1	65.5	54.8	37.5
(2019/10/03 16:50:02.00)	56.9	83.8	67.7	59	38
(2019/10/03 16:55:03.00)	55.5	70.3	67	59.7	40.8
(2019/10/03 17:00:03.00)	56.2	73.6	67.9	59.8	40.7
(2019/10/03 17:05:03.00)	56.3	71.1	66	61.6	40.6
(2019/10/03 17:10:03.00)	55.8	76	68.6	57.2	41.3
(2019/10/03 17:15:02.00)	54.4	72.4	66	57.8	39.3

(2019/10/03 17:20:02.00)	57.6	72.5	68.8	61.8	38.6
(2019/10/03 17:25:02.00)	54.1	70.3	65.3	58.1	39.3
(2019/10/03 17:30:02.00)	55.1	71.7	67	59.2	39.7
(2019/10/03 17:35:02.00)	57.8	73.1	68.7	62.3	39.6
(2019/10/03 17:40:02.00)	53.5	68.4	65.2	56.9	43
(2019/10/03 17:45:02.00)	57.3	72.6	68.8	61.7	43.4
(2019/10/03 17:50:02.00)	57.5	72.2	69	61.5	42.8
(2019/10/03 17:55:02.00)	55.1	69.4	65.9	59	41.7
(2019/10/03 18:00:02.00)	57.3	74.4	68.2	60.8	43.1
(2019/10/03 18:05:02.00)	55.6	77.7	66.3	58.7	39.6
(2019/10/03 18:10:02.00)	54.2	69.5	65.8	58	41.3
(2019/10/03 18:15:02.00)	56.4	71.6	67.3	60.9	42.4
(2019/10/03 18:20:02.00)	53	69.8	64.8	56.9	41.8
(2019/10/03 18:25:02.00)	53.1	73.1	65.5	56	41.7
(2019/10/03 18:30:02.00)	54.6	71.9	66.6	58.2	42.6
(2019/10/03 18:35:02.00)	50.3	62.4	60.6	53.6	42.6
(2019/10/03 18:40:02.00)	51.6	66.4	64	54.8	42.8
(2019/10/03 18:45:02.00)	52.8	69.3	64.8	55.9	42.4
(2019/10/03 18:50:02.00)	50.8	64	61.5	55.1	42.7
(2019/10/03 18:55:02.00)	53.1	70.3	64.8	56.1	42.3
(2019/10/03 19:00:02.00)	55.4	73.2	68	58.7	42.7
(2019/10/03 19:05:02.00)	46.5	64.7	59	45.2	41.9
(2019/10/03 19:10:02.00)	48.9	66	61.7	47.9	42.2
(2019/10/03 19:15:02.00)	52.9	68.2	65	56.6	42.3
(2019/10/03 19:20:02.00)	49.2	63.7	61.5	51.3	41.4
(2019/10/03 19:25:02.00)	54.9	68.9	66.2	59.5	41.9
(2019/10/03 19:30:02.00)	57.7	75.2	70.3	60.5	41
(2019/10/03 19:35:02.00)	53.8	70.7	66.7	56.3	42
(2019/10/03 19:40:02.00)	56.1	74.9	68.8	58.5	40.9
(2019/10/03 19:45:02.00)	52.2	70.9	65.4	53.3	40
(2019/10/03 19:50:02.00)	48.4	67.7	60.8	47.6	39.7
(2019/10/03 19:55:02.00)	56	70.4	67.2	60.5	41.7
(2019/10/03 20:00:02.00)	53.1	67.8	66	56.8	39.9
(2019/10/03 20:05:02.00)	56.1	80.4	67.9	53.2	39
(2019/10/03 20:10:02.00)	47.5	66.5	62.3	45.1	39.4
(2019/10/03 20:15:03.00)	53.9	71.3	66.2	56.9	43.3
(2019/10/03 20:20:02.00)	54.5	73.7	65.5	57.6	44.7
(2019/10/03 20:25:03.00)	54.7	73.8	67.9	56.3	41.4
(2019/10/03 20:30:02.00)	52.3	70.4	63.8	55.6	41.3
(2019/10/03 20:35:02.00)	51.3	69.7	64.8	51.9	40.3
(2019/10/03 20:40:02.00)	52.1	71	64.5	53.8	39.8
(2019/10/03 20:45:02.00)	53.4	67.9	65.9	56.3	40.5
(2019/10/03 20:50:02.00)	53.5	74.2	67.1	49.6	39.3
(2019/10/03 20:55:02.00)	48.6	68.9	61.4	48.4	39.4
(2019/10/03 21:00:02.00)	52.4	72.3	66	51.8	40.8
(2019/10/03 21:05:02.00)	49.5	67.6	63	48.7	38.9

(2019/10/03 21:10:02.00)	45.2	62.4	58.2	43.7	39.4
(2019/10/03 21:15:02.00)	51	70	63.1	52.5	38.8
(2019/10/03 21:20:02.00)	53.3	70.1	65.9	56	41.9
(2019/10/03 21:25:02.00)	54.7	70.8	66.8	57.5	46.2
(2019/10/03 21:30:02.00)	52	72.3	64.1	51.4	41
(2019/10/03 21:35:02.00)	54.1	74.1	68.1	51.7	43.8
(2019/10/03 21:40:02.00)	56.2	75.1	68.1	58.4	46.1
(2019/10/03 21:45:03.00)	55.8	73.5	68.1	58.4	45.2
(2019/10/03 21:50:03.00)	54.7	70.3	66.9	58.4	43.1
(2019/10/03 21:55:02.00)	47.9	64.6	60.7	47.6	41.5
(2019/10/03 22:00:02.00)	52.7	70.3	65.9	53	40
(2019/10/03 22:05:02.00)	49.5	66.6	63.2	48.6	40.8
(2019/10/03 22:10:02.00)	49.5	64.9	61.6	48.8	41.4
(2019/10/03 22:15:02.00)	48.8	66.8	61.5	49.9	40.4
(2019/10/03 22:20:02.00)	51	69.1	65.1	50.4	39.8
(2019/10/03 22:25:02.00)	41.9	50.6	47.1	44.3	39.2
(2019/10/03 22:30:02.00)	40.1	46.4	44.8	42	37.8
(2019/10/03 22:35:02.00)	46.6	65	59.6	46.4	38.6
(2019/10/03 22:40:02.00)	49.8	70.9	61.7	48.8	38.5
(2019/10/03 22:45:02.00)	39.9	47.9	46.4	42	37.1
(2019/10/03 22:50:02.00)	47.4	67.4	59.9	46.5	38.9
(2019/10/03 22:55:02.00)	49.2	65.8	62.9	48.3	41.3
Average	54.5	70.5	65.1	55.1	40.5
Maximum	61.4	83.8	76.5	62.3	46.2
Position 1 Night-time					
(2019/10/03 23:00:02.00)	50.6	69.8	63.3	50.7	39.3
(2019/10/03 23:05:02.00)	46.1	66.8	58.5	43.6	37
(2019/10/03 23:10:02.00)	47.6	68.2	60.9	42.4	36
(2019/10/03 23:15:02.00)	51.7	68.1	65.6	51.2	36.7
(2019/10/03 23:20:02.00)	39.3	46.7	45.1	42.2	36.4
(2019/10/03 23:25:02.00)	49.4	71.2	63.3	43.7	36.8
(2019/10/03 23:30:02.00)	38.3	46.3	41.9	39.9	36.5
(2019/10/03 23:35:02.00)	48.3	68.5	60.1	50.1	36.4
(2019/10/03 23:40:02.00)	46.6	60.9	59.7	48.4	37.4
(2019/10/03 23:45:02.00)	40.4	48.7	45.9	42.9	36.3
(2019/10/03 23:50:02.00)	39.8	46.2	44.1	41.9	37.2
(2019/10/03 23:55:02.00)	41.6	50.7	45.3	43.7	37.1
(2019/10/04 00:00:02.00)	43	56.8	55.3	42.4	35.9
(2019/10/04 00:05:02.00)	48.4	69.8	61.8	43	35.6
(2019/10/04 00:10:02.00)	49.9	67.6	63.9	48.8	39.4
(2019/10/04 00:15:02.00)	39.2	46	43.6	41.1	36.1
(2019/10/04 00:20:02.00)	35.8	44	40.8	37.2	34.1
(2019/10/04 00:25:02.00)	49.5	72.5	62.4	42.5	34.8
(2019/10/04 00:30:02.00)	35.4	41.3	39.4	37.1	33.6
(2019/10/04 00:35:02.00)	47	68.4	61.2	36.8	32.3
(2019/10/04 00:40:02.00)	33.6	39.3	36.5	35.1	32.1

(2019/10/04 00:45:02.00)	46.3	64	61.6	41.7	31.9
(2019/10/04 00:50:02.00)	32.1	38.4	36	33.5	30.6
(2019/10/04 00:55:02.00)	32.6	43.7	37	34.1	30.8
(2019/10/04 01:00:02.00)	47.9	64.8	61.1	47.4	32.1
(2019/10/04 01:05:02.00)	48.6	70.9	61.8	38	31.4
(2019/10/04 01:10:02.00)	34.5	42.1	38.5	36.2	32.6
(2019/10/04 01:15:02.00)	33	38.7	36.7	34.3	31.4
(2019/10/04 01:20:02.00)	33.3	43.4	38.3	34.9	31.3
(2019/10/04 01:25:02.00)	31.9	36.8	34.6	32.9	30.8
(2019/10/04 01:30:02.00)	32.6	43.4	35.7	34	31.3
(2019/10/04 01:35:02.00)	32.3	42.3	36.9	33.3	30.9
(2019/10/04 01:40:02.00)	31.8	37.6	35.2	33	30.7
(2019/10/04 01:45:02.00)	31.5	38.5	33.8	32.7	30.3
(2019/10/04 01:50:02.00)	32.7	41.1	35.6	33.8	31.5
(2019/10/04 01:55:02.00)	50.9	71.6	65.2	47.8	32.8
(2019/10/04 02:00:02.00)	32.7	36.1	34.8	33.6	31.8
(2019/10/04 02:05:02.00)	34.4	42.2	37.6	35.6	33
(2019/10/04 02:10:02.00)	45.6	60.2	58.2	46	33.4
(2019/10/04 02:15:02.00)	44.7	62.7	60	40.4	35.2
(2019/10/04 02:20:02.00)	38.3	41.7	40.5	39.4	37.2
(2019/10/04 02:25:02.00)	39.6	42.3	41.2	40.5	38.5
(2019/10/04 02:30:02.00)	41.3	45.2	43.6	42.5	40
(2019/10/04 02:35:02.00)	40.5	44.1	42.2	41.4	39.5
(2019/10/04 02:40:02.00)	39.1	42.5	41.3	40	38.2
(2019/10/04 02:45:02.00)	48.4	68.4	62.8	43	39.2
(2019/10/04 02:50:02.00)	41.5	47.2	46.2	42.2	40.2
(2019/10/04 02:55:02.00)	47.6	67.3	61.5	42.7	39.5
(2019/10/04 03:00:02.00)	41.5	43.6	43	42.3	40.6
(2019/10/04 03:05:02.00)	42	45.7	43.9	43	40.6
(2019/10/04 03:10:02.00)	47.3	68.6	60.5	44.3	41.2
(2019/10/04 03:15:02.00)	42.2	45.8	44.7	43.3	41
(2019/10/04 03:20:02.00)	40.8	43.1	42.3	41.7	40
(2019/10/04 03:25:02.00)	41.2	48.4	43.2	42.2	40
(2019/10/04 03:30:02.00)	41.8	47.6	43.7	42.8	40.8
(2019/10/04 03:35:02.00)	41.3	44.8	43	42.1	40.3
(2019/10/04 03:40:02.00)	39.5	44.4	41.8	40.5	38.2
(2019/10/04 03:45:02.00)	41.6	47.8	44.3	42.8	40
(2019/10/04 03:50:02.00)	41.5	45.2	44	42.7	40.2
(2019/10/04 03:55:02.00)	50.2	72.7	63.5	43.4	40
(2019/10/04 04:00:02.00)	46.7	67.2	59.7	44.7	41.1
(2019/10/04 04:05:02.00)	41.3	44.1	43.1	42.2	40.3
(2019/10/04 04:10:02.00)	41.1	44.7	43.4	42.1	40.1
(2019/10/04 04:15:02.00)	40.9	50.2	48.2	41.6	38.9
(2019/10/04 04:20:02.00)	49.4	67.4	64.5	46.3	38.2
(2019/10/04 04:25:02.00)	39	45.5	41.3	40	37.9
(2019/10/04 04:30:02.00)	39.4	48	42	40.7	37.7

(2019/10/04 04:35:02.00)	39.2	43.7	41.6	40.5	37.7
(2019/10/04 04:40:02.00)	38.2	42.1	40.2	39.1	37
(2019/10/04 04:45:02.00)	38.2	41.3	40.3	39.2	37.1
(2019/10/04 04:50:02.00)	39.3	44.4	42.6	40.6	38
(2019/10/04 04:55:02.00)	39.1	41.9	41	40.2	37.5
(2019/10/04 05:00:02.00)	51	71.3	64.3	48	37.9
(2019/10/04 05:05:02.00)	50.4	70.3	64.8	49.2	40.1
(2019/10/04 05:10:02.00)	42.4	49.4	45.7	43.3	41.3
(2019/10/04 05:15:02.00)	48.5	69.2	61.2	45.9	41.7
(2019/10/04 05:20:02.00)	47.8	68.4	60.9	44.2	41.3
(2019/10/04 05:25:02.00)	49.7	67.6	62.7	48.4	42.1
(2019/10/04 05:30:02.00)	45.7	56.4	54.8	45.7	43.1
(2019/10/04 05:35:02.00)	55.1	74	69.1	55.3	42.9
(2019/10/04 05:40:02.00)	50.9	68.7	64.5	51.6	43
(2019/10/04 05:45:02.00)	52.1	67.4	65	52.9	44
(2019/10/04 05:50:02.00)	53.6	72.1	67.1	54.2	44.7
(2019/10/04 05:55:02.00)	49.8	69.2	61.8	48	45.8
(2019/10/04 06:00:02.00)	48.5	64.6	59.4	48	45.4
(2019/10/04 06:05:02.00)	53.9	70.6	66.9	54.5	45.6
(2019/10/04 06:10:02.00)	55.3	72	69.2	57.1	44.3
(2019/10/04 06:15:02.00)	51.2	66.1	63.4	53.7	44.1
(2019/10/04 06:20:02.00)	52.3	66.4	64.3	54.3	44.5
(2019/10/04 06:25:02.00)	56.4	72.4	68.8	60.3	44.7
(2019/10/04 06:30:02.00)	50.9	67.3	63.2	51.2	43.9
(2019/10/04 06:35:02.00)	55.2	71.7	67.9	58.4	43.9
(2019/10/04 06:40:02.00)	53	72	65.6	55.1	43.1
(2019/10/04 06:45:02.00)	51.8	72.3	65.3	49.1	43.9
(2019/10/04 06:50:02.00)	51.6	70.7	64.9	51.4	43.9
(2019/10/04 06:55:02.00)	53.8	70.8	67.5	54.2	43.4
Average	48.0	55.8	51.8	43.6	38.1
Maximum	56.4	74	69.2	60.3	45.8
Position 1 Daytime					
(2019/10/04 07:00:02.00)	57.1	73.5	69.2	60.6	44
(2019/10/04 07:05:02.00)	55.2	74.9	68	56.8	44.3
(2019/10/04 07:10:02.00)	54.4	70.5	66.2	58	43.9
(2019/10/04 07:15:02.00)	51.5	66.9	65	51.5	43.7
(2019/10/04 07:20:02.00)	56.7	71	67.4	60.8	44.3
(2019/10/04 07:25:02.00)	55.3	72.7	67.8	58.2	43.3
(2019/10/04 07:30:02.00)	54.5	70.6	66	58.3	43.3
(2019/10/04 07:35:02.00)	57.4	73.4	68.9	60.9	43.7
(2019/10/04 07:40:02.00)	58.5	74.6	70.8	62.4	44.1
(2019/10/04 07:45:02.00)	57.4	74.6	68.3	61.9	44.1
(2019/10/04 07:50:02.00)	56.7	69.8	67	61.4	43.8
(2019/10/04 07:55:02.00)	57.5	72.8	68.1	62.3	44
(2019/10/04 08:00:02.00)	55.7	70.8	66.2	59.8	43.5
(2019/10/04 08:05:02.00)	58.6	73	69.6	63.2	42.8

(2019/10/04 08:10:02.00)	57.6	72.4	68.5	61.9	43.5
(2019/10/04 08:15:02.00)	55	68.8	66.1	59.8	43
(2019/10/04 08:20:02.00)	57.5	73.1	67.8	62	43.5
(2019/10/04 08:25:02.00)	58.6	71.9	68.1	63	45.5
(2019/10/04 08:30:02.00)	59.9	76.4	70.1	63.4	44.4
(2019/10/04 08:35:03.00)	61	79.1	71.6	64.5	44.5
(2019/10/04 08:40:02.00)	58.2	72.3	69.5	62.5	43
(2019/10/04 08:45:02.00)	59.1	73.1	69.5	63.5	44.1
(2019/10/04 08:50:02.00)	57.6	74.4	68.4	61.2	44.5
(2019/10/04 08:55:02.00)	57.2	75.9	68.8	60.7	44.1
(2019/10/04 09:00:03.00)	58.2	70.6	68.2	63	44.7
(2019/10/04 09:05:02.00)	57.6	80.5	68.9	60.6	45
(2019/10/04 09:10:02.00)	58.4	76.7	70	61.8	44.9
(2019/10/04 09:15:02.00)	56.8	74.7	68.8	60	44.9
(2019/10/04 09:20:02.00)	57.6	74	68.5	61.7	43.5
(2019/10/04 09:25:02.00)	57.7	75	68.2	62.5	43.5
(2019/10/04 09:30:02.00)	53.6	71.4	66.9	54.7	43.7
(2019/10/04 09:35:03.00)	55.6	71.4	67.9	59.1	43.4
(2019/10/04 09:40:02.00)	58.7	81.4	70.4	61.2	44.6
(2019/10/04 09:45:03.00)	55	75	67.3	56.8	43
(2019/10/04 09:50:03.00)	53.5	69.7	65.6	57.4	41.3
(2019/10/04 09:55:03.00)	57.4	74.2	69.3	61.5	39.7
(2019/10/04 10:00:03.00)	55.8	72.6	68.6	58.6	37.8
(2019/10/04 10:05:02.00)	47.9	63.1	60.3	49.8	38.9
(2019/10/04 10:10:02.00)	56.6	72.6	67.4	61.2	39.9
(2019/10/04 10:15:02.00)	57.3	83.1	69.4	59.3	40.3
(2019/10/04 10:20:03.00)	59.3	78.2	71.7	61.8	39.8
(2019/10/04 10:25:02.00)	54.3	69.6	66.8	57.4	39.9
(2019/10/04 10:30:02.00)	52.3	68.2	64.6	54.9	40.3
(2019/10/04 10:35:02.00)	52.2	68	63	56.9	39.8
(2019/10/04 10:40:02.00)	52.6	69.4	65.8	54.8	39.4
(2019/10/04 10:45:02.00)	52.5	67.9	64.4	55.2	40
(2019/10/04 10:50:02.00)	51.2	65.8	63	54.6	39.6
(2019/10/04 10:55:02.00)	54.2	71.3	67.9	55.9	40.5
(2019/10/04 11:00:02.00)	56.3	74.1	69.8	58.1	39.5
(2019/10/04 11:05:02.00)	51.8	67.5	65.1	54	39.9
(2019/10/04 11:10:02.00)	52.7	71.4	64.5	55	39.9
(2019/10/04 11:15:02.00)	55.1	71.9	66.8	58.7	39.9
(2019/10/04 11:20:02.00)	53.1	73.6	64.4	56.5	40.7
(2019/10/04 11:25:02.00)	53.4	68.6	65.6	56.7	40.5
(2019/10/04 11:30:02.00)	58.8	74.7	69.9	62.7	39.6
(2019/10/04 11:35:02.00)	56.4	70.3	66.7	61	39.4
(2019/10/04 11:40:02.00)	58.3	79.2	70.3	61.5	41.3
(2019/10/04 11:45:03.00)	54.9	74.6	66.4	58.1	39.6
(2019/10/04 11:50:02.00)	59.1	84.6	69.8	58.7	39
(2019/10/04 11:55:03.00)	52.8	68.1	64.1	57.4	38.4

(2019/10/04 12:00:03.00)	54.7	73	67.3	57.7	37.8
(2019/10/04 12:05:03.00)	52.2	68	64.3	55.9	37.5
(2019/10/04 12:10:03.00)	55.1	69.8	67.2	59.3	38.9
(2019/10/04 12:15:02.00)	55.4	71.4	67.8	59.5	37.6
(2019/10/04 12:20:02.00)	52.3	71.5	66.5	50.3	38.1
(2019/10/04 12:25:02.00)	54.1	72.7	67.3	56.5	37.2
(2019/10/04 12:30:02.00)	49.8	66.5	62.8	51.8	36.1
(2019/10/04 12:35:02.00)	50	65.9	62	54.9	36.5
(2019/10/04 12:40:02.00)	55	71	66.5	59.3	38.4
(2019/10/04 12:45:02.00)	57.1	81.7	67.4	57.7	38.3
(2019/10/04 12:50:03.00)	52.9	68.7	65.6	55.8	38.5
(2019/10/04 12:55:03.00)	59.5	77.8	72.2	62.5	39.3
(2019/10/04 13:00:02.00)	55.4	72.4	67.2	59.6	36.4
(2019/10/04 13:05:02.00)	57.1	77.6	68.8	60	36.5
(2019/10/04 13:10:03.00)	53.3	72.5	67	52.8	35.4
(2019/10/04 13:15:03.00)	52.9	68.3	64.8	56.9	35.9
(2019/10/04 13:20:03.00)	62.4	85.7	72	61.9	37.8
(2019/10/04 13:25:02.00)	53	70.4	64.9	58.3	36.6
(2019/10/04 13:30:02.00)	54.6	72	65.4	59.2	36.4
(2019/10/04 13:35:02.00)	53.1	69.1	65.9	56.3	40.1
(2019/10/04 13:40:02.00)	49.6	70.4	63.2	48.8	37.3
(2019/10/04 13:45:02.00)	55.6	75.6	66.8	59.1	38.4
(2019/10/04 13:50:02.00)	53.6	67.5	64.3	57.4	40.8
(2019/10/04 13:55:02.00)	52.3	68.1	64.4	56.8	38
(2019/10/04 14:00:03.00)	51.2	69.6	63.2	54.8	37.6
(2019/10/04 14:05:03.00)	53.6	72.1	64.9	57.4	37.6
(2019/10/04 14:10:03.00)	55.3	71.5	67.4	58.5	36.8
(2019/10/04 14:15:02.00)	54.1	69.9	65.4	58.4	37.6
(2019/10/04 14:20:02.00)	49.4	69.5	61.2	53.8	37.7
(2019/10/04 14:25:02.00)	56	69.5	66.4	60.3	44
(2019/10/04 14:30:02.00)	53.2	69	64.5	55.6	46.3
(2019/10/04 14:35:02.00)	57.3	72.4	68.4	61.6	41
(2019/10/04 14:40:02.00)	53.7	68.1	65.3	58	40.3
(2019/10/04 14:45:02.00)	57.5	78.3	69.4	59.4	41
(2019/10/04 14:50:03.00)	55.8	71.6	66.2	60.5	40.9
(2019/10/04 14:55:03.00)	58.4	73.4	68.3	63	38.8
(2019/10/04 15:00:03.00)	57.7	78	71.6	59.5	39.7
(2019/10/04 15:05:02.00)	55.5	70.1	65.8	60.2	39.4
(2019/10/04 15:10:02.00)	57.5	70.6	66.9	62.1	40.8
(2019/10/04 15:15:02.00)	54.9	66.7	65.1	59.9	39.8
(2019/10/04 15:20:02.00)	59.3	74.6	69.6	63.7	40.7
(2019/10/04 15:25:02.00)	61.3	87.3	69.6	63.5	37.7
(2019/10/04 15:30:02.00)	59.1	71.7	68	63.5	42.6
Average	56.4	72.5	67.1	58.8	40.7
Maximum	62.4	87.3	72.2	64.5	46.3
Date/Situation	L_{Aeq}	L_{Amax}	L_{A01}	L_{A10}	L_{A90}

Position 2					
(2019/10/03 13:30:00.00)	46	58.3	54.8	48.5	42.1
(2019/10/03 13:34:59.00)	45.2	51.5	49.7	47.4	42.6
(2019/10/03 13:40:00.00)	45.2	54.6	50.6	47.5	41.8
(2019/10/03 13:45:00.00)	45	61.6	49.9	47.3	41.9
(2019/10/03 13:50:00.00)	47.2	56.3	51.9	49.2	44.7
(2019/10/03 13:55:00.00)	46.4	60.9	52.1	48.7	42.9
Average	45.8	57.2	51.5	48.1	42.7
Maximum	47.2	61.6	54.8	49.2	44.7
Position 3					
(2019/10/03 14:10:00.00)	42.8	53.1	48.9	45.3	39.4
(2019/10/03 14:15:00.00)	43.9	54.1	50.9	45.5	41.4
(2019/10/03 14:20:00.00)	46.2	62	55	48.2	41.9
(2019/10/03 14:25:00.00)	42.9	60.3	48.6	44.6	40.3
(2019/10/03 14:30:00.00)	42.3	61	48.3	44.3	39.8
(2019/10/03 14:35:00.00)	42.6	55.9	47.1	44.1	40.8
Average	43.5	57.7	49.8	45.3	40.6
Maximum	46.2	62	55	48.2	41.9

APPENDIX E

INDICATIVE SOUND INSULATION PERFORMANCE OF DIFFERENT WINDOW CONFIGURATIONS

Third octave band centre frequency Hz	Sound Insulation (dB) for Glass Thickness (mm)																					
	4/16/4 or 4/12/4		6/12/6		6/12/6.4 PVB		10/12/4		10/12/6		10/12/6.4 PVB		Acoustic Laminate									
													6/12/7		6/12/11		10/12/16		13/12/13		16/12/16	
100	25		17		19		23		27		27		25		26		26		30		31	
125	24	24	26	20	24	21	28	25	27	26	28	27	27	26	25	26	28	27	27	28	34	32
160	23		22		21		26		24		26		26		25		26		27		33	
200	21		18		19		19		24		26		23		25		24		31		34	
250	21	20	18	19	19	20	23	22	29	27	30	29	24	25	28	28	28	27	38	34	38	37
315	19		24		24		26		31		32		28		32		31		39		39	
400	22		27		28		31		33		34		30		35		34		41		43	
500	25	25	29	29	32	31	33	33	34	34	36	36	34	33	39	38	38	37	44	44	46	45
630	30		33		34		36		37		40		37		43		41		48		48	
800	33		37		38		39		39		41		42		46		44		51		50	
1000	36	35	39	38	40	39	41	40	41	40	42	41	45	44	47	47	45	45	53	52	48	46
1250	38		39		40		41		41		41		46		47		46		52		43	
1600	40		39		39		41		39		41		46		46		44		49		43	
2000	41	38	34	36	35	37	45	43	37	38	42	42	45	46	43	43	42	44	45	47	46	46
2500	35		37		39		45		40		44		48		42		44		48		50	
3150	31		42		44		42		43		49		51		47		51		52		53	
4000	40	35	47	45	49	47	44	44	47	46	53	52	52	52	54	51	56	54	57	55	59	57
R_m dB	29		30		31		34		34		36		36		37		39		42		42	
R_w dB	31		33		34		36		38		40		38		41		42		45		46	
R_{TRA} dBA	25		26		27		29		32		34		31		33		37		38		41	

Notes:
1. The glass thickness is presented in terms of the thickness of one pane of glass, followed by the size of the air gap, followed by the thickness of the second pane of glass, all dimensions in millimetres.
2. 6.4mm PVB glass denotes a laminated glass consisting of a tough plastic interlayer made of polyvinyl butyral (PVB) bonded together between two panes of glass.

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